

## **SECTION 731**

### **TIMBER PRESERVATIVES AND TREATMENT**

This Section covers the preservative and treatment of timber where preservative treatment is specified.

#### **731.01. TIMBER PRESERVATIVES AND TREATMENT.**

- (a) **Materials.** Timber preservative treatment shall conform to the requirements of AASHTO M 133. Unless otherwise provided, the type of preservative used shall be as follows:
  - 1. **Creosote Oil and Creosote Solutions.** These preservatives shall be used for piling and structural grade timber.
  - 2. **Creosote Oil, Creosote Solutions, Oil-Borne Preservative and Water-Borne Chromated Copper Arsenate.** These preservatives shall be used for guard rail posts, spacer blocks, guide posts, fence posts, and post bracing.
- (b) **Preparation for Treatment.**
  - 1. **General Requirements.** All lumber, timber, piling, and posts shall be of the grade and size specified and shall be inspected for grade and size immediately prior to the treatment.
  - 2. **Inspection.** All materials and processes used in the treatment shall be subject to inspection at the manufacturer's plant, which shall be equipped with all necessary gauges, appliances, and facilities to enable the inspector to satisfy himself that the requirements of the Specifications are fulfilled. Inspection for conformity with the specified treatment shall be in accordance with the current AWP Standard M2.
- (c) **Handling.** After treatment the lumber or timber shall be handled carefully, piled properly, and allowed to dry thoroughly.

## **SECTION 732**

### **MATERIALS FOR GUARD RAIL, GUIDE POSTS, BRIDGE RAIL, MISCELLANEOUS RAILING AND FENCES**

This Section covers the requirements for materials for guard rail, guide posts, bridge rail, miscellaneous railing, fences, and gabion wire baskets.

#### **732.01. METAL BEAM RAIL.**

- (a) **Beams.** Corrugated steel beams shall conform to the requirements of AASHTO M 180 for the gauge specified on the Plans.
- (b) **Guard Rail Posts and Spacer Blocks.**
  - 1. **Steel Posts.** Steel posts and spacer blocks shall be of the length and size shown on the Plans. Hot rolled (forged) steel shapes shall conform to the requirements of AASHTO M 183 and shall be furnished galvanized in accordance with AASHTO M 111. All punching, drilling, cutting, shearing, and grinding shall be performed prior to galvanization. Surface defects shall be repaired by grinding, cutting, welding, or other industry acceptable method, then coated with two coats of zinc-dust zinc-oxide primer meeting the requirements of Section 730. Alternate repair techniques shall be those shown in ASTM A 780, Repair of Hot-Dip Galvanized Coatings.

Steel posts and spacer blocks fabricated by the methods and requirements of ASTM A 769 are acceptable alternates. These fabricated posts shall not vary by more than 5 percent from the mass, dimensions and section properties shown for acceptable hot rolled (forged) shapes. Dimensions, mass, and section properties shall conform to the current edition of the American Institute of Steel Construction (AISC) Manual of Steel Construction, or from the supplier's technical publications endorsed by the AISC.

Sharp sheared edges on the fabricated posts and spacer blocks shall be dulled in the upper 18 inches (450 mm) of the post and all edges on the block. Any industry acceptable method to dull these edges may be used, such as grinding, secondary rolling, or sand or shot-blasting. This operation and all hole drilling, punching, cutting, shearing, butt welding, etc., shall be fully completed prior to galvanization. Galvanization shall comply with AASHTO M 111 and repair techniques as covered above.

Tests on either type of steel post and compatible spacer blocks shall follow test procedures in the appropriate Specifications. Each cut post or spacer block is one unit of a lot, which consists of a maximum of 200 units and/or the remainder thereof. One failure in any lot shall require testing on two other units. Failure of two of the three selected units from any lot shall be cause for rejection of the entire lot.

Testing may be done in the field for visual, mechanical, or electronic checks to ensure the units adhere to the requirements of AASHTO M 183, ASTM A 769, and/or AASHTO M 111. Suppliers of fabricated beams shall submit their quality control procedures to the Materials Division for approval prior to production of any material for use on Department Contracts. Suppliers of hot rolled (forged) or fabricated beams shall certify their product complies with all pertinent Sections of the appropriate Specifications for production and galvanization. Upon Department approval of the quality control procedures, written notice will be sent to suppliers.

Steel base plates and miscellaneous fabricated guard rail hardware shall be of the section and length as shown on the Plans. Connections to posts (cut to proper length) shall be as shown on the Plans. All cutting, welding, and drilling required shall be completed prior to galvanization. Steel plate shall conform to the requirements of AASHTO M 183 and the galvanization shall conform to requirements of AASHTO M 111.

2. **Wood Posts.** Wood posts and spacer blocks shall be of the length and size specified on the Plans. Both type posts (sawed and round) and sawed spacer blocks shall be cut from live trees and shall be close grained. Posts and blocks shall contain only sound wood.
  - 2.1. **Sawed Posts and Spacer Blocks.** Sawed posts and spacer blocks shall be of the size and length shown on the Plans. They shall meet the requirements of Section 727 for timber and lumber, furnished rough. Minimum stress grade shall be 1200 F unless otherwise shown on the Plans.
  - 2.2. **Post Weakening.** The leading posts in the approach anchor unit shall be weakened by drilling holes at the ground line as shown on the Plans.
  - 2.3. **Preservative Treatment and Inspection.** Wood posts and spacer blocks shall be preservative treated in accordance with Section 731.

The size of the post or block shall be determined at the preservative treatment plant immediately prior to treatment. The diameter of round posts shall be determined by a circumference-diameter tape. Minimum diameter at the bottom edge of the slabbled

face shall not exceed 3/4 inch (20 mm) less than the nominal diameter, and the actual diameter at any point shall not vary from the nominal diameter by more than 1 inch (25 mm), over or under.

All sawing, chamfering, boring, slabbing, or cutting shall be performed prior to preservation treatment. The only exceptions are the holes shown drilled at the ground line for weakening the leading posts in the approach anchor unit, or holes enlarged or drilled into new wood to facilitate guard rail attachment. These holes shall be thoroughly and uniformly treated by pulling or pushing a preservative solution saturated rag through or into the holes. Multiple passes of the saturated rag may be required to obtain the treatment level required.

- (c) **Guard Rail Hardware.** Unless otherwise specified, all fittings, bolts, washers, and other accessories shall be galvanized in accordance with the requirements of AASHTO M 111 or M 232, whichever may apply.

### 732.02. GUIDE POSTS.

Guide posts and underdrain marker posts shall be as shown on the Plans.

### 732.03. METAL BRIDGE RAILING MATERIALS.

1. **Structural Steel Shapes for Posts and Rails.** Structural steel shapes for posts and rail shall meet the requirements of Section 724.
2. **Metal Beams.** Metal beams shall meet the requirements of Subsection 732.01.
3. **Aluminum Alloy Tubes.** Aluminum alloy tubes for bridge railing shall meet ASTM B 221, alloy 6063 or 6061 T6.

Welding, when shown on the Plans or permitted, shall be in accordance with Subsection 720.03(a)1.

A certificate of analysis executed by the producer shall be furnished to the Department, setting forth the chemical analysis and test results for tubes.

4. **Cast Aluminum Alloy Bridge Railing Posts.** Cast aluminum alloy bridge railing posts shall meet the requirements of AASHTO M 193.

Welding, when shown on the Plans or permitted, shall be in accordance with Subsection 720.03(a)1.

- 4.1. **Anchor Bolts.** Anchor bolts and anchoring methods for cast aluminum alloy bridge railing posts shall be as shown on the Plans.

### 732.04. PIPE RAILING.

- (a) **Galvanized Steel Pipe and Fittings.** Galvanized steel pipe and fittings shall meet the requirements of ASTM A 53, standard weight pipe. The requirement for hydrostatic testing shall be waived.
- (b) **Black Steel Pipe and Fittings.** Black steel pipe and fittings shall comply with the requirements of ASTM A 53, standard weight pipe. The requirement for hydrostatic testing shall be waived.

### 732.05. WIRE CABLE AND FITTINGS.

Materials shall meet the requirements of AASHTO M 30.

**732.06. FENCE, STYLE WWF OR FENCE, STYLE SWF.**

- (a) **Description.** This item covers the materials requirements for fabric, strand wire, and other wire items, frame work for fence and gates, and all fastening and bracing hardware necessary for the construction of woven wire or strand wire fence. The height of fence, or number of strands, the height and size of opening for gates, and the shape, size, and length of posts shall be as shown on the Plans or in the Proposal.
- (b) **Materials.**
  - 1. **Wire Items.**
    - 1.1. **Woven Wire.** The woven wire shall be design number 832-6-12-1/2 with a Class 1 zinc coating meeting the requirements of AASHTO M 279 or wire of design number 832-6-12-1/2 with a Class 1 aluminum coating meeting the requirements of ASTM A 584.
    - 1.2. **Barbed Wire.** Zinc coated steel (galvanized) barbed wire shall consist of two strands of 12-1/2 gage (2.51 millimeter diameter) steel wire twisted in the same direction, or in alternate directions, with 14 gage (2.03 millimeter diameter) full or half-round 4 point barbs spaced 5 inches (127 mm) apart, with a Class 1 zinc coating on the 12-1/2 gage (2.51 millimeter diameter) wire. Also acceptable is wire consisting of two strands of 15-1/2 gage (1.70 millimeter diameter) steel wire twisted in alternate directions, with 16-1/2 gage (1.47 millimeter diameter) full round 4 point barbs spaced 5 inches (127 mm) apart. The coating shall be a Class 3 zinc coating on the 15-1/2 gage (1.70 millimeter diameter) wire. The wire described here shall meet all requirements of AASHTO M 280. Aluminum coated steel barbed wire shall consist of two strands of 12-1/2 gage (2.51 millimeter diameter) steel wire twisted in the same or in alternate directions, with 14 gage (2.03 millimeter diameter) full or half-round 4 point barbs spaced 5 inches (127 mm) apart. The wire may be furnished with aluminum coated steel wire barbs, or with aluminum alloy barbs. The strands (main wires) shall be aluminum coated steel barbed wire meeting the requirements of ASTM A 585. Any barbed wire furnished shall have a minimum assembly break strength of 950 pounds (4.23 kN).
    - 1.3. **Smooth Wire.** Smooth zinc coated (galvanized) carbon steel wire may be substituted for the top wire or any or all barbed wire shown on the Plans or in the Proposal, with the approval of the Engineer. The smooth wire shall meet the requirements of ASTM A 641, and be one of the following : 11 gage (3.05 millimeter diameter) medium or hard temper, minimum 85 ksi (586.1 MPa) tensile strength with a Class 1 coating, or 9 gage (3.76 millimeter diameter) soft temper, minimum 60 ksi (413.7 MPa) tensile strength with a Class 1 coating.
    - 1.4. **Barbless Wire.** Zinc coated steel (galvanized) barbless wire shall consist of two strands of 12-1/2 gage (2.51 millimeter diameter) steel wire twisted in the same direction, or in alternate directions, with a Class 1 zinc coating. Also acceptable is wire consisting of two strands of 15-1/2 gage (1.70 millimeter diameter) steel wire twisted in alternate directions with a Class 3 zinc coating. The wire described here shall meet all requirements of AASHTO M 280. Aluminum coated steel barbless wire shall consist of two strands or 12-1/2 gage (2.51 millimeter diameter) steel wire twisted in the same or alternate direction.

The wires shall have a minimum Class 1 aluminum coating. Aluminum coated steel barbless wire shall meet the requirements of ASTM A 585. All barbless wire furnished shall have a minimum assembly break strength of 950 pounds (4.23 kN).

- 1.5. **Tension Wire.** Diagonal steel tension wire may be either size listed in Subsection 732.06(b)1.3.
- 1.6. **Fan, Corner, End, Stretcher and Gate Posts.** These posts shall be treated wood of the length and nominal diameter as shown on the Plans. They shall be sound and reasonably straight and shall be treated in accordance with Section 731 of the Specifications. The minimum wood post quality standard grades are shown in ASTM F 537, Section 6.3.
- 1.7. **Line Posts.** Line posts shall be either preservative treated wood of the nominal diameter or steel of acceptable shape and mass, and the specified length shown on the Plans or in the Proposal. The kind of material selected shall be used throughout any one project except in cases where the Engineer approves a mixture of materials in writing. Wood line posts shall meet the post quality standards of ASTM F 537, Section 6.3, and shall be preservative treated as covered in Section 731 of the Specifications. Steel posts shall meet the requirements of AASHTO M 281. They shall be furnished galvanized or painted, and have an adequate number of deformable clip protrusions on the post, or be furnished with the same number of wire ties as the number of strands to be joined to the posts.
- 1.8. **Post Ties (Wire Ties).** Post ties shall meet the requirements of AASHTO M 281 and shall be furnished with a Class 1 zinc coating in minimum 11 gage (3.05 millimeter diameter).
- 1.9. **Gates.** Gates may be furnished with a pipe or tubular framework covered with the same type strand or woven wire as the fence. Pipe or tubing for the gate frames shall meet the requirements of ASTM A 53, standard weight steel pipe (Schedule 40) but the pressure testing (hydrostatic) requirement will be waived. The minimum size will be 1.66 inch (42.2 mm) outside diameter pipe with a wall thickness of 0.140 inch (3.56 mm). The frame shall be covered and braced as indicated on the plans. Fittings, latches, and hinges shall be a type approved by the Engineer. Pipe or tubing may be substituted for the pipe specified above. The substitution formulation will be as shown on the plans or in Subsection 732.07(c)2.2.

Commercially available ranch-type metal panel gates may be furnished as an alternate unless otherwise shown on the plans. Acceptance will be based on visual inspection by the Engineer. Aluminum coated steel, aluminum alloy or galvanized steel, mill finish or painted, are all acceptable materials for this item.

- 1.10. **Hardware.** Various hardware items, hinges, and gate latches shall be furnished as shown on the Plans or as recommended by the gate manufacturer. They shall be furnished galvanized in accordance with ASTM A 90 and AASHTO M 232, or with a protective coating compatible with the gate coating or alloy. Eye bolts for fastening fence to existing headwalls or wingwalls on culverts shall be furnished galvanized.
- 1.11. **Staples.** Staples used for fastening wire to wood shall be made of 9 gage (3.76 millimeter diameter) galvanized wire. They shall be minimum 1 1/2 inch (38.1 mm) long.

- 1.12. *Nails.* Nails shall be round or oval steel wire. They shall be 40 pwt. nails or 20 pwt. spikes, and furnished galvanized.

**732.07. FENCE, STYLE CLF.**

- (a) **Description.** This item covers the materials requirements for chain link fabric and other wire items, framework for the fence and gates, and all fastening and bracing hardware necessary for the construction of chain link type fence. The height of the fence fabric, the width and height of the gate openings, the size, shape and length of posts and the size and shape of framework members shall be as shown on the plans or in the proposal.
- (b) **Classifications.** The following classifications and combinations of acceptable materials will be used throughout this Specification:
1. *Fence, Style CLF, Type I* shall consist of zinc coated (galvanized) steel wire fabric on either a steel or aluminum mounting system.
  2. *Fence, Style CLF, Type II* shall consist of aluminum coated steel wire fabric on either a steel or aluminum mounting system.
  3. *Fence, Style CLF, Type III* shall consist of aluminum alloy fabric on either steel or aluminum mounting system.
  4. *Fence, Style CLF, Type IV* shall consist of vinyl coated or PVC plastic coated galvanized steel wire fabric on either zinc-coated steel or aluminum mounting system of the same color or a harmonizing color.
  5. *Fence, Style CLF, Type XX, NOBAR.* This nomenclature indicates any of the four combinations of acceptable materials and NOBAR indicates no barbed wire climb barriers above the fence fabric.
  6. *Fence, Style CLF, Type XX, BARR.* This nomenclature indicates any of the four combinations of acceptable materials and BARR indicates fence fabric topped by the number of strands of barbed wire climb barrier as shown on the plans.
  7. *Nomenclature.* The full nomenclature as shown in Subsection 732.07(b) 5 and 6 is for ordering information only. Unless otherwise specified on the plans, the "Type" is optional with the Contractor. The fence pay item may not contain the full nomenclature.
- (c) **Materials.**
1. *Wire Items.*
    - 1.1. *Fabric.* Unless otherwise specified, the fabric shall be 9 gage (3.76 millimeter diameter) wire woven in 2 inch (50.8 mm) mesh. Unless otherwise specified herein, or on the Plans and in the Proposal, all fabric shall meet the minimum requirements of AASHTO M 181 and references for the type fabric used.
    - 1.2. *Tension Wire.* The tension wire shall meet the requirements of AASHTO M 181, Class 1 with a minimum zinc coating mass/unit volume of 0.8 ounce/ft<sup>2</sup>(244.1 g/m<sup>2</sup>).
    - 1.3. *Barbed Wire.* Barbed wire shall meet the requirements of Subsection 732.06(b)1.2.
    - 1.4. *Post Ties.* Post ties shall comply with Subsection 732.07(c)3.4.
    - 1.5. *Wire Ties.* Wire ties shall comply with Subsection 732.07(c)3.4.

2. **Framework Items.**

- 2.1. **End (Terminal), Stretcher (Pull), Corner, and Gate Posts** shall be the size, shape, and length as shown on the plans or in the proposal. Fan posts shall be the same type of post, shape, and size and of a length necessary to provide a smooth top line on the fence. Pipe for round posts shall be Grade 1 steel posts or Grade 2 steel posts meeting the requirements of AASHTO M 181. Grade 1 steel posts shall be pipe meeting the requirements of ASTM A 53 or F1083 with a minimum 1.8 ounce/ft<sup>2</sup> (549.3 g/m<sup>2</sup>) zinc coating. The post shall have the dimensions shown on the plans for the height of fence specified. The hydrostatic tests will be waived on the pipe used for fence posts, and the pipe shall be furnished with plain ends.

Roll-formed shapes (other than round) shall be furnished in the size, shape, and length shown on the plans. Unless otherwise specified, they shall be furnished with a minimum 549.3 g/m<sup>2</sup> ft. zinc coating and be fabricated from steel sheet meeting the requirements of ASTM A 570, Grade 45. See Subsection 732.07(c)2.2 for round roll-formed post shapes, materials, and substitution formula.

- 2.2. **Line Posts.** Line posts shall be the size, shape, and length shown on the Plans or in the Proposal for the height of fence as specified, and as shown in Subsection 732.07(c)2.1.

Grade 2 steel posts shall be round pipe or tubing manufactured by cold rolling and electric resistance welding of steel strip. Exterior and interior corrosion resistance coating shall conform to the requirements of AASHTO M 181. This applies to material used in Subsections 732.07(c)2.3 and 732.07(c)2.4.

Properties (dimensions, mass, and section modulus) for the round pipe as shown in the schedule on the standard drawing are for Schedule 40 pipe, meeting the requirements of ASTM A53, (galvanized) zinc coated. Pipe meeting the requirements for grade 2 pipe of AASHTO M 181 are acceptable substitutes. The pipe (or tubing) shall be tested to determine the tensile and yield strengths, and the following criteria shall be met. The product of the section modulus (from the schedule on the standard drawing) multiplied by 25,800 (177.9) [minimum yield strength in psi (MPa) for Schedule 40 pipe] shall be equal to or be exceeded by the product of the section modulus of the grade 2 pipe multiplied by its tested yield strength in psi (MPa). Steel used in grade 2 pipe shall have a minimum 50,000 psi (344.7 MPa) yield strength. The outside diameters of the substituted pipes shall be within 0.1 inch (2.54 mm) of the Schedule 40 pipe and the section modulus of the grade 2 (cold-formed process) pipe shall be determined by the formula:

$$SM = B (OD^4 - ID^4) / (32 \times OD)$$

where: SM = Section Modulus  
 OD = Outside Diameter  
 ID = Inside Diameter  
 B = 3.1416 (a constant)

Thickness measurement of the pipe shall be made with micrometers accurate to 0.0004 inch (0.01 mm).

- 2.3. **Rail (Braces and Top Rail).** Material for top rail and braces shall meet the requirements of ASTM A 501, ASTM A 53, or ASTM F 1083 and be furnished in the size and shape

shown on the Plans or in the Proposal. They shall be furnished galvanized to comply with ASTM A 53. See Subsection 732.07(c)2.2 for round roll-formed brace and rail materials and substitution formula. Dimensions, mass, and section properties shown on the Plans are those of ASTM A 501. When substituting for ASTM A 53 pipe, use the same outer diameter pipe. Hydrostatic testing on ASTM A 53 pipe shall be waived.

- 2.4. **Gate Frame.** Material for gate frames shall be the size and shape as shown on the Plans or in the Proposal. They shall meet the requirements of ASTM A 501, ASTM A 53, or ASTM F 1083 and be furnished galvanized to the requirements of ASTM A 53. See Subsection 732.07(c)2.2 for round roll-formed framework materials and substitution formula. Dimensions and section properties shown on the plans are those of ASTM A 501. When substituting for ASTM A 53 pipe, use the same outer diameter pipe. Hydrostatic testing on ASTM A 53 pipe shall be waived.
3. **Fence Fittings.** The materials requirements, coating Specifications, and inspection procedures of the following items necessary for chain link fence erection are covered in ASTM F 626, as amended herein:
  - 3.1. Post and line post caps.
  - 3.2. Rail and brace ends.
  - 3.3. Sleeves for top rail.
  - 3.4. Tie wire and clips, minimum 12 gage (2.69 millimeter diameter) with 0.8 ounce/ft<sup>2</sup> (244.1 g/m<sup>2</sup>) zinc coating, or aluminum wire as shown.
  - 3.5. Tension and brace bands.
  - 3.6. Tension bars.
  - 3.7. Truss rods.
  - 3.8. Barb arms.

### **732.08. FENCE, STYLE GDF.**

- (a) **Description.** This item shall cover the materials requirements for fence fabric and other wire items, framework for the fence, and all fastening and bracing hardware necessary to construct glare deflector fence. The height of the fence fabric and the type of mounting system shall be as shown on the Plans or in the Proposal.
- (b) **Classifications.** The following classifications and combinations of acceptable materials will be used throughout this Specification:
  1. **Fence, Style GDF, Type I** shall comply with Subsection 732.07(b)1.
  2. **Fence, Style GDF, Type II** shall comply with Subsection 732.07(b)2.
  3. **Fence, Style GDF, Type III** shall comply with Subsection 732.07(b)3.
  4. **Fence, Style GDF, Type IV** shall comply with Subsection 732.07(b)4.
  5. **Fence, Style GDF, Type XX, RAILMTD.** This nomenclature indicates any of the four combinations of acceptable materials and RAILMTD indicates glare deflector fence mounted on guard rail.



6. **Fence, Style GDF, Type XX, POSTMTD.** This nomenclature indicates any of the four combinations of acceptable materials and POSTMTD indicates glare deflector fence mounted on ground mounted posts.
  7. **Fence, Style GDF, Type XX, WALLMTD.** This nomenclature indicates any of the four combinations of acceptable materials and WALLMTD indicates glare deflector fence mounted on parapet wall or median barrier.
  8. **Nomenclature.** The full nomenclature as shown in Subsection 732.08(b) 5 through 7 is for ordering information only. Unless otherwise specified on the Plans, the "Type" is optional with the Contractor. The fence pay item may not necessarily contain the full nomenclature.
- (c) **Materials.**
1. **Wire Items.**
    - 1.1. **Fabric.** Unless otherwise specified, the fabric shall be 9 gage (3.76 millimeter diameter) wire woven in 1 inch (25.4 mm) mesh. All other materials references shall be as covered in Subsection 732.07(c)1.1.
    - 1.2. **Tension Wire.** Tension wire shall be as shown in Subsection 732.07(c)1.2.
    - 1.3. **Post Ties.** Post ties shall be as shown in Subsection 732.07(c)3.4.
    - 1.4. **Wire Ties.** Wire ties shall be as shown in Subsection 732.07(c)3.4.
  2. **Framework Items.** All framework items, posts, line posts, top rail and brace rail shall be as shown in Subsection 732.07(c)2.1 through 2.3.
  3. **Fence Fittings.** All fittings shall be as shown in Subsection 732.07(c)3.1 through 3.8.

## 732.09. WIRE BASKETS FOR GABIONS AND REVETMENT MATTRESSES.

- (a) **General.** Wire baskets shall be constructed of double twisted hexagonal wire mesh or, when specified in the Plans, welded-wire mesh. The wire mesh shall be nonraveling mesh that will not separate at any of the twists or detach at any welded connections forming the mesh if a single wire in the mesh is cut.
- (b) **Wire Requirements.** The mesh, selvage, lacing, internal-connecting, and spiral wire shall meet the requirements of ASTM A 641, Class 3, Soft [Tensile Strength 55-75 ksi (380-520MPa)] and ASTM A 853. The wire shall have High Grade or Special High Grade zinc coating as described in ASTM B 6, Table 1. For welded-wire mesh, the coating uniformity shall equal or exceed four 1-minute dips by the Preece Test, as determined by ASTM A 239.
- (c) **Twisted-wire mesh baskets.**
  1. **General.** The mesh wires shall be wrapped around the selvage wire with the number of turns necessary to interconnect each of them with adjacent mesh wires. All wire shall be galvanized before fabrication of mesh.
  2. **Gabions.** Galvanized baskets shall be manufactured from 11-gage (3.0mm) mesh wires and 9-gage (3.9 mm) selvage wires. PVC-coated baskets shall be manufactured from 12-gage (2.7 mm) mesh wire and 10-gage (3.4 mm) selvage wire.
  3. **Revetment Mattresses.** For 12 inch (300 mm) thick revetment mattresses, the baskets shall be manufactured from 13.5-gage (2.2 mm) mesh wires and 12-gage (2.7 mm) selvage wire. For thinner revetment mattresses, the baskets shall be manufactured from 13.5-gage (2.2 mm) mesh wires.

(d) **Welded-Wire Mesh Baskets.**

1. **General.** Wire welds shall be made using resistance welding. The mesh shall conform to ASTM A 185, "Steel Welded Wire Fabric - Plain for Concrete."
2. **Gabions.** The baskets shall be manufactured from 11-gage (3.0 millimeter) wire. PVC-coated baskets shall be manufactured from 12-gage (2.7 millimeter) wire.
3. **Revetment Mattresses.** For 12 inch (300mm) thick revetment mattresses, the baskets shall be manufactured from 13.5-gage (2.2 mm) mesh wires. For thinner revetment mattresses, the baskets shall be manufactured from 14-gage (2.0 mm) mesh wires.

(e) **Connection Wires.** The following table shall be used for connection wire sizes:

<u>Wire Type</u>	<u>Minimum Wire Size</u>
Lacing Wire	13.5-gage (2.2 mm)
Spiral Wire	12-gage (2.7 mm)
Internal Connecting Wire	13.5-gage (2.2 mm)

A sufficient quantity of lacing wire and connection wire shall be supplied to securely fasten all edges of the Gabion baskets and diaphragms.

(f) **Basket Strength and Flexibility Requirements.**

1. **Elongation.** Elongation tests shall be made, before fabrication of the baskets, on a wire sample 12 inches (300 mm) long. Elongation shall not be less than 12% in accordance with the requirements of ASTM A370-92.
2. **Strength.** The following "punch" test and table of strengths shall be met when tested according to the Colorado Procedure for Methods of Conducting Strength Tests of Gabions (CP I-6130).
3. **Punch Test.** The 3 inch x 5 inch (75 mm x 125 mm) wire mesh shall not rupture when subjected to a load of 6000 lbs (26.7 kN) when applied as follows:
  - (a) Place in testing machine seats, without binding individual wires, a section 6 feet (1.83 m) long, not less than 3 feet (0.91 m) wide including the selvedge bindings, for 3 feet (0.91 m) along the width, or in the middle for widths greater than 3 feet (0.91 m), with the excess falling free on each side.
  - (b) Apply tension to elongate the section 10%.
  - (c) Apply the load, 6000 pound (26.7 kN) as stated above, to 1 square foot (0.093 square meters) located approximately in the center of the sample between the clamps. The direction of the load should be perpendicular to the elongation tension force direction and be applied with a circular ram head with the edges beveled or rounded to prevent cutting the wires.

<b>TABLE OF STRENGTHS</b>			
	<b>Gabions, <u>Galvanized</u></b>	<b>Gabions, PVC <u>Coated</u></b>	<b>Revetment <u>Mattresses</u></b>
Wire mesh-pulled parallel to wire twist	2300lb/ft (34 kN/m)	2000lb/ft (29 kN/m)	1800lb/ft (26 kN/m)
Wire mesh-pulled perpendicular to wire twist	1800 lb/ft (26 kN/m)	1400lb/ft (20 kN/m)	900lb/ft (13 kN/m)
Wire mesh connection to selvages	1400lb/ft (20 kN/m)	1200lb/ft (18 kN/m)	900lb/ft (13 kN/m)
Joint connection strength-lacing wire or ring wire fastener	1400lb/ft (20 kN/m)	1200lb/ft (18 kN/m)	900lb/ft (13kN/m)

- (g) **PVC Coating.** PVC coating shall be extruded onto the wire and the PVC-coated wire shall meet the following requirements:

<b>Property</b>	<b>PVC COATING Tolerance Limits</b>
Coating Thickness	Nominal 20 mils (500µm), Minimum 15 mils (380µm)
Specific Gravity <sup>a</sup>	1.20-1.40, ASTM D 2287, D 792
Tensile Strength <sup>a</sup>	Minimum 2900 psi (20 Mpa), ASTM D 412
Modulus of Elasticity <sup>a</sup>	Minimum 2600 psi (18 Mpa) @ 100% strain, ASTM D 412
Brittleness Temperature	Maximum -10EC, ASTM D 746
Abrasion Resistance <sup>a</sup>	12% max. Wt. Loss, Method D ASTM D 1242, Method B at 200 cycles, CSI-A Abrader _Tape, 80 Grit
Salt Spray Test <sup>b</sup>	Minimum 3,000 hours, ASTM B 117
Ultraviolet Light Exposure <sup>b</sup>	Minimum 3,000 hours, apparatus type E @ 145°F (63EC), ASTM D 1499, G 23

- <sup>a</sup> After the salt spray and ultraviolet light testing, reject the PVC coating if specific gravity, tensile strength, modulus of elasticity, or resistance to abrasion have changed more than 6%, 25%, 25%, or 10%, respectively, from initial values.
- <sup>b</sup> Reject the PVC coating if after the salt spray and ultraviolet light testing the coating is cracked, blistered, split, or shows noticeable change of color.
- (h) **Certification.** A type A certification shall be furnished for the wire and PVC coating in accordance with Subsection 106.04. A type D certification shall be furnished for gabion and revetment mattress baskets.